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**TOW CATCH FOR FIBER PLACEMENT
HEAD****CROSS-REFERENCE TO RELATED PATENT
APPLICATIONS**

This patent application claims the benefit of U.S. Provisional Patent Application No. 60/819,677, filed Jul. 10, 2006, the disclosure and teachings of which are incorporated herein in their entirety, by reference.

FIELD OF THE INVENTION

This invention relates to automated fiber placement machines, and more particularly to a method and apparatus for precluding withdrawal of a fiber tow away from a fiber placement head, in the event of breakage of the tow and/or failure of a tow clamping mechanism to hold the tow in place after the tow is cut during a cut/add operation.

BACKGROUND OF THE INVENTION

During automated fiber placement, a number of tows, or tapes, of fiber are typically fed in parallel fashion, as a band of tows, through a fiber placement head to a compaction roller which places the tows onto the surface of a tool. Each individual tow or tape is supplied from a spool, which is typically located in a stationary creel. The fiber placement head is typically movable, by an automatic controller, to orient the compaction roller properly for placing the band of tows onto the tool surface. Because the fiber placement head may move a considerable distance, in multiple directions, with respect to the creel, each of the fiber tows or tapes is typically routed through a number of redirects in traversing the distance between the creel and the head.

For various reasons, including preventing droop and tangling of the individual plys during certain motions of the fiber placement head, each fiber tow or tape is typically held in tension, between the creel and the fiber placement head. Tensioners inside the creel are often used for creating this tension.

During the automated fiber placement process, it is sometimes necessary to cut some of the tows to create openings for holes, windows, or other features in the part being constructed, or to narrow the band of tows that are being simultaneously laid down in parallel onto the tool surface. Conversely, tows may later be added back into the band of tows being laid down, when a wider band is desired.

In order to allow for the addition and cutting of tows, during the automated fiber placement process, fiber placement heads typically include various mechanisms for cutting and/or adding a tow. These mechanisms typically include a pinch cylinder, or other clamping mechanism, for holding the cut tow, or a tow not yet added to the band, in place at the fiber placement head, against the tension applied to the tow, so that the tow being held is not retracted away from the fiber placement head.

In the event that the pinch cylinder or tow clamping mechanism should fail, however, or a tow should break between the pinch cylinder and the creel, the tension on the tow will tend to draw the tow back toward the creel. This is an undesirable occurrence, because rethreading the tow through all of the redirects and feeding it back to the fiber placement head can be a complex and time-consuming process, during which the automated fiber placement operation must be shut down.

It is desirable, therefore, to provide an improved method and apparatus for holding a tow in place at the fiber placement

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head in the event of a malfunction of a pinch cylinder or breakage of the tow between the pinch cylinder and the creel.

BRIEF SUMMARY OF THE INVENTION

The invention provides an improved apparatus and method for selectively clamping a fiber tow against a support of a fiber placement head, in a manner allowing one-way motion of the tow in a forward direction from an input side to an output side of the support, and precluding motion of the tow in a reverse direction from the output side to the input side of the support, through use of a tow catch apparatus mounted on the fiber placement head, at a position along the forward path of the tow before the shears and clamps of a cut/add mechanism.

In one form of the invention, a tow catch, for selectively clamping a fiber tow against a support, in a manner allowing one-way motion of the tow in a forward direction from an input side to an output side of the support, and precluding motion of the tow in a reverse direction from the output side to the input side of the support, includes an arm, adapted for pivotable motion about a pivot point disposed at a minimum distance from the support, and terminating in a distal end of the tow catch disposed at a distance greater than the minimum distance from the support. The distal end of the arm is adapted for resting against the tow on the output side of the support. By virtue of this arrangement, motion of the tow in the reverse direction urges the arm to pivot in the reverse direction about the pivot point, in such a manner that the distal end of the arm clamps the tow between the distal end of the arm and the support. Conversely, motion of the tow in the forward direction, causes the pivot arm to pivot in a forward direction about the pivot point in such a manner that the distal end of the arm does not clamp the tow against the support.

In some forms of the invention, the distal end of the arm may be roughened, by a process such as knurling or grooving, or the distal end of either or both of the arm and the support may be conformable, for example, to thereby facilitate clamping of the tow between the distal end of the arm and the support. In some forms of the invention, the support may be adjustably positionable with respect to the pivot point. In some forms of the invention, the support may be defined by an outer periphery of a guide wheel mounted for rotation in at least a forward direction about a guide wheel axis which is offset from and extends substantially perpendicular to the forward direction of travel of the tow. The guide wheel axis may be adjustably positionable with respect to the pivot point, in some forms of the invention.

A tow catch, according to the invention, may further include a spring, operatively connected between the pivot point and the arm for urging the arm to pivot about the pivot point in the reverse direction. The spring may be selectively adjustable to provide a variable spring force acting on the arm for urging the arm to pivot about the pivot point in the reverse direction.

The arm of a tow catch, according to the invention, may also include a manual release lever, extending from the arm and adapted for application of a force thereto for pivoting the arm in a forward direction about the pivot point, to thereby lift the distal end of the arm away from the support.

A tow catch, according to the invention, may further include a roller, rotatably attached to the arm by a one-way clutch, and having an outer periphery thereof which defines the distal end of the arm and/or tow catch and is adapted for contact with the tow. The one-way clutch is configured and oriented to allow rotation of the roller by the tow when the tow